1850MNRAS..10...66H

An Account of some Improvements in a Speculum Grinding and Polishing Machine. By John Hippisley, F.R.A.S.

"The machine, as far as regards the general action of two excentric pins, which transmit motion to the grinding and polishing tools, is similar in principle to that adopted by Lord Rosse, and other machines previously in use.

"The improvements consist in the arrangement of the parts so as to effect cheapness and facility in the construction, with general convenience in use, and *especially* in the manner in which the polishing tool is connected with the apparatus which gives it motion.

"This connexion is made by a ball and socket-joint of a novel construction,* which, while it transmits a perfectly equable motion without jerks or irregularities to the polisher and leaves it free also to revolve about its own centre, as the friction between it and the speculum may direct, facilitates the application of counterpoise weights, so as to counterbalance in any required degree the weight of the polisher, especially in the very last period of the polishing.

"A polisher of considerable lightness has justly been deemed indispensable, and, for this purpose, wood has been used instead of metal in its construction. This material is, however, obviously liable to unsymmetrical alteration of figure, from unequal expansion and contraction by moisture and heat.

"Nor does it, it is submitted, adequately fulfil the condition required, namely, that of sufficiently removing pressure from the speculum. It appears almost demonstrable that the last finishing action of the polisher will be exerted with most advantage, to the perfection both of figure and polish, when it moves without any vertical pressure whatever. Those who are familiar with the adjustment of reflecting telescopes are aware that the slightest confinement or pressure on the speculum, when in its place in the telescope, is sufficient to impair its power of definition, in other words, to alter temporarily, in some degree, however small, its figure. A pressure, certainly far less than that which a wooden polisher will exert, is capable of producing this injurious effect.

"It is, then, to be expected, that when a speculum has been receiving its final figure under any pressure, that there will be some, however slight, recession from that figure when the pressure is removed; and, if so, the remedy obviously is to diminish *successively*, by counterpoises, the weight of the polisher as the figure and polish are advancing, till it ultimately moves, in giving the last finishing strokes, without any more pressure than the cohesion between the polished and sliding surfaces affords. It may also be expected that the lustre and perfection of the polish itself will be enhanced, inasmuch as the size of the abraded atoms will

---

* A plan of the ball and socket-joint accompanied the memoir, which was further elucidated by a working model. Unfortunately Mr. Hippisley's stay in London was not long enough to allow the model to be sufficiently considered.

1850MNRAS..10...66H

then be at their minimum, since they diminish in a direct ratio with the diminution of pressure by the abrading surface.

"In the machine to which these observations refer, the pulley which drives one excentric rod is made to differ slightly in diameter from its fellow, with which it is connected by the endless band, which gives motion to the other excentric rod; so that the centre of the polisher, by their joint action, is constrained to describe curves, varying from nearly a straight line to ellipsoids having a minor axis equal to twice the thrust of the shorter excentric; and the parabolic figure is attained by the maintenance of a certain proportion, found experimentally, between the throws of these two excentrics. This proportion, for a speculum having an aperture of one inch for each foot of focal length, and under the action of a polisher of the same dimensions as the speculum, is one-third of the diameter of the speculum for the longer, and one-seventh for the shorter thrust; the figure of the speculum receding towards a spherical figure if that shorter thrust be diminished, or advancing to the hyperbolic curvature if it be increased.

"The counterpoises, then, it is suggested, should be added successively, and at those periods in the action of the machine when it may be considered that its tendency to give a parabolic figure is at its maximum; that is, when, by the combined action of the excentric pins, the centre of the polisher is describing the widest ellipsoids on the speculum. A bent wire is so placed, as an index, on the excentric rod that its point, traversing a scale fixed in any convenient position, shows the exact moment when these widest ellipsoids are being described: at those intervals the counterpoise-weights are successively added, so that the polisher may be considered to pass through *complete* cycles of its action under each alteration and diminution of pressure.

"Attention to these conditions has, in specula finished by the machine, apparently been entirely successful, both in obtaining an exceeding fine polish, and a figure which does not sensibly deviate from the parabolic.

"A nice attention to the quantity and purity of the water used in the polishing is also of much importance. A very convenient method, which, being self-acting, requires no particular care during the process, is to fix a small vessel on the excentric rod, with a thread depending from it, and so adjusted that the single drop which by the capillary and syphon action passes from the thread shall, at the extreme thrust of the excentric rod, be deposited at the edge of the speculum. The quantity may be nicely regulated by the use of a smaller or larger thread; and the water is secure from containing any gritty particle, being filtered in its passage through the thread.

"The machine is of an easy and cheap construction, and intended to be worked by the foot acting on a treadle, or by any other convenient motive power: the same lever apparatus which is used for counterpoising the polisher in finishing, being connected by a vertical rigid bar with the ball and socket joint of the tool,

1850MNRAS..10...68D

affords means for adding any required amount of pressure in the rough grinding process, and thus that tedious part of the operation is considerably accelerated. It is also adapted for figuring lenses of large dimensions, to which it would impart, as well as to specula, surfaces approaching nearly to those of parabolic, or other required geometric curvatures, and with the addition of another mandril, or more, receiving rapid motion from the periphery of the fly-wheel, it has been used with great convenience for grinding and polishing lenses of the smallest dimensions.

On the Construction of a small Observatory, a new Stand for a Transit Instrument, and an Eye-piece for facilitating the Rectification of Instrumental Errors by Reflexion.[*] By John Drew, F.R.A.S.

"A very excellent 5-foot telescope by Dollond, which had been tested by Captain W. H. Smyth, who mentions it with approbation in the *Celestial Cycle*, came into my possession some time since. To use this instrument with advantage I constructed a small observatory, which has answered the purpose so well that I beg to offer a plan of the building for the use of such members of the Astronomical Society as may wish to have a convenient lodgment for moderate sized instruments at a small expense. I have followed, in most respects, the description given by the Rev. W. R. Dawes of his observatory, in vol. vii. No. 10, of the *Monthly Notices*, the principal difference being in the walls, which are formed of ¾-inch weather boarding, the planks overlapping about 1½ inch; the roof only is covered with canvass outside the boards. The experience of two winters satisfies me that the structure is weather-proof.

"Before the foundation was laid, the ground was excavated to the depth of 18 inches and filled up with concrete; on this, brickwork is raised 6 inches above the ground. An oaken curb is laid on the brickwork, into which are inserted uprights 2½ inches by 2, and 6 feet in height. These are united at the top to a corresponding curb, and outside of these are nailed the boards forming the walls.

"The observatory consists of two compartments, the equatoreal-room and the transit-room; the former is 9 feet in diameter, in the form of a duodecagon; the roof is nearly circular, and similar to that of Capt. Smyth at Bedford, with shutters opening in the side, increasing from 9 inches to 2 feet 6 inches in width. The lower curb of the roof and the upper curb of the wall are fitted with cast-iron plates, between which are the 3-inch cannon-balls which support the roof and enable it to revolve. The telescope is mounted with a polar axis having the usual adjustments: the right ascension and declination circles are each 15 inches in diameter, and read off,

---

[*] Drawings accompanied this paper, and a model of the transit and stand was presented at the same time by Mr. Drew.